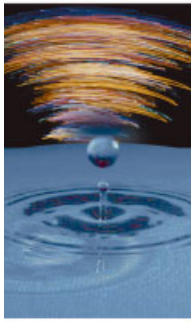

For more information:
http://water-energy.lbl.gov

Water and Energy Technology Team
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Water and Energy Technology Team

• Water Quality • Industrial Usage • Urban Usage

• Agricultural Usage • Wastewater

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The Water-Energy Connection

Worldwide, water and energy are inextricably linked in purifying water, treating wastewater, powering and processing industrial operations, irrigating crops, cleaning our clothes, and pumping water to our cities.

Globally, 7% of energy is used in delivering water. Energy is also a considerable input in the supply and treatment of water. Significant opportunities exist for simultaneously increasing efficiencies in both the water and energy sectors. Lawrence Berkeley National Laboratory (LBNL) has led in developing the technology and tools to improve energy efficiency, resulting in significant reductions in energy intensity of the economy over the last 25 years. LBNL is now applying this same approach to water use.

LBNL provides clients throughout the world with treatment and conservation alternatives that can help increase water supply and reduce water and energy demand. More than 20 years of experience developing and applying highly flexible, state-of-the-art policy analysis models and tools, combined with expertise in hydrogeology and reservoir dynamics, microbial ecology and environmental engineering, probabilistic cost-effectiveness analysis, energy auditing, and assessment of water- and energy-efficient technologies, enables LBNL to assist clients in choosing the best alternative to a particular water/energy challenge.

Saving water saves energy, and saving energy saves water.

Economic and Technology Analysis

The LBNL Water and Energy Technology Team (WETT)'s mission is to achieve sustainability through efficient technologies and integrated management of water and energy resources.

Identifying efficiency opportunities requires an understanding of how water is currently used. LBNL is a world leader in real time monitoring and data management necessary to extract information from large amounts of data. The foundation of evaluating efficiency opportunities is economic life-cycle cost analysis (LCC), which assesses the impacts of policy options on a variety of users. LBNL is a world leader in developing and applying LCC to policy analysis.

In addition to LCC, LBNL uses the following analyses:

- National Resource Savings (NRS): a forecast of future national resource impacts
- Net Present Value (NPV) National Economic Impacts: a forecast of the economic impacts or contribution to national economic growth
- Utility Impacts: a forecast of incremental costs, benefits, and infrastructure requirements for resource supply utilities
- Employment Impacts: an estimate of potential incremental impacts of policy on employment and jobs.

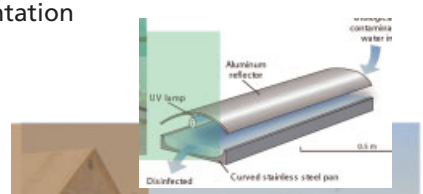
Water Quality

One quarter of the people in developing countries have no access to safe drinking water. Traditional forms of purification require significant amounts of energy for transport, desalinization, or boiling.

Nationally, in cooperation with local and regional water agencies, LBNL has helped pioneer innovative management solutions to California's complex water supply and quality problems. Real-time monitoring and the application of decision support systems to improve environmental decision-making are LBNL's main thrusts in California. These, and other solutions, are applicable to arid zones worldwide. Other solutions include geographic information systems (GIS)-based wetland water quality modeling; selenium fate and transport investigations in support of EPA-mandated TMDLs; quantification of algal growth in agricultural and wetland channels; and development of a portable limnological field instrument for precise bed sediment sampling.

Globally, LBNL is pioneering the implementation of UVWaterworks—an inexpensive, low-maintenance, field-tested method of disinfecting domestic drinking water using energy-efficient, fluorescent UV light. This technology, invented by LBNL and now licensed worldwide, meets WHO and U.S. EPA standards for all viral and bacterial pathogens.

New opportunities for LBNL include regional groundwater conjunctive use modeling and planning; use of remote sensing data and models in hydroclimate, water resources and agro-economic assessments; and the use of innovative metrics and optimization criteria in integrated basin water resource planning and management.



Industrial Usage

Industrial applications, such as steam systems, papermaking, cement, food processing, and metal casting operations, often require large amounts of both energy and water. The generation of energy itself often necessitates water for resource extraction and power plant cooling.

Industries consume large amounts of water during the production of basic materials, manufactured goods, and energy. LBNL analyses of energy-saving opportunities in industries have included assessments of alternative technologies; identification of costs and savings for increased efficiency; and development of energy-efficiency supply curves to rank opportunities by cost and savings potential.

LBNL has begun to extend such analyses to include water-saving opportunities. Through the evaluation of actual processes, LBNL performs technology assessments and calculates water and energy benchmarks for various industries. LBNL's industry assessments cover iron and steel, pulp and paper, cement, chemicals, beer-making, motor vehicle assembly, wet corn milling, and steam systems.

Partnerships with industrial end-users and associations have led to the creation of training and educational materials that promote the optimization of water and wastewater systems such as pumping and compressed air.

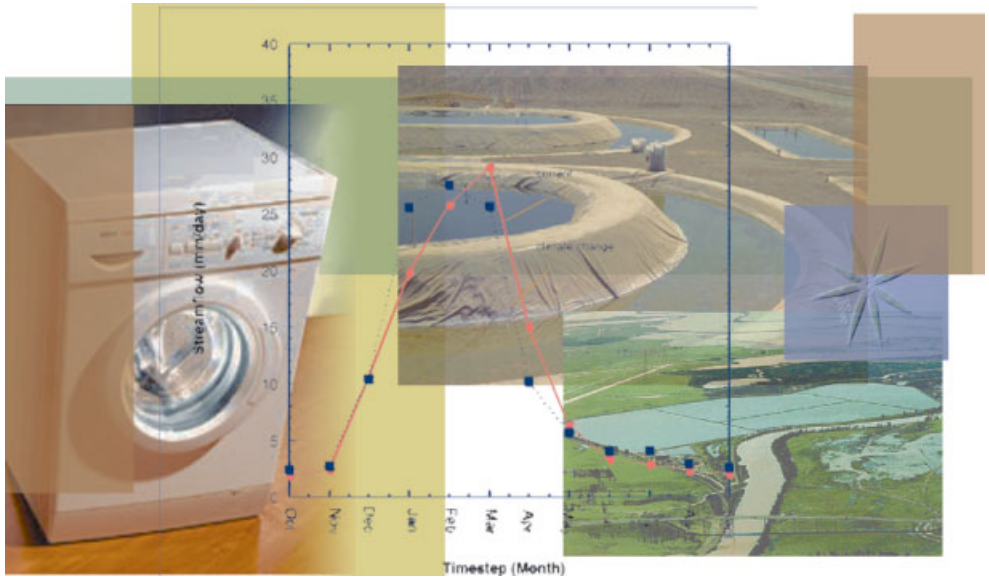
Urban Usage

Even in areas with sufficient water supply, treating water and wastewater to meet minimum health standards can be a significant part of a community's energy use—in some cases up to 65%. Urban drought regions often have to have water transported or pumped from underground aquifers to meet the needs of the population. Both of these activities require energy as do water-intensive urban applications like clothes washing, toilet flushing, and plumbing.

Water has generally been considered a free resource. Historically this was not a problem because water in most populated areas was plentiful. However, as supplies have become strained, a fundamental reexamination of how water and wastewater are used is necessary. In every agricultural, residential, or commercial water use application examined to date, LBNL has identified opportunities to do the same job using less water, often with little or no increase in cost. One such example is low-flow toilets, which cost the same as standard toilets, yet use less than half the water.

To assist communities in conserving water resources, LBNL has identified the feasibility and cost of engineering design changes that could increase water and energy efficiency for specific products; analyzed scenarios in which these technologies are adopted; and assessed the potential policy impacts in various countries on consumers, manufacturers, utility companies, the nation, and the environment.

LBNL is exploring new opportunities to work with the building sector (commercial, specialized, and residential) to assess water end-use demand characteristics.



Agricultural Usage and Wastewater

Energy consumption and water usage in the agricultural sector are particularly interdependent in the area of pumping; 85% of California's electricity for agriculture is used for pumping water and irrigation. Agricultural water usage and water quality are also linked since discharge threatens water quality for wildlife and urban areas.

LBNL is at the forefront in developing alternative water and wastewater treatment technologies that require less energy and land, reduce capital and operational costs, and provide higher effluent quality. LBNL wastewater treatment technologies, applicable to the municipal, industrial, and agricultural sectors, offer many advantages:

- Minimizing energy use and recovering methane for power generation
- Reducing biosolid accumulation
- Controlling microalgae to provide oxygen photosynthetically, thereby assimilating nutrients at 1/2 to 1/10 the energy use of conventional wastewater treatments
- Lowering construction and operational costs
- Recovering nitrogen for fertilizer or animal feed
- Making effluent safe for irrigation reuse.

LBNL is examining alternative scenarios and comparing them using life-cycle cost analysis.